Migration, Remittances and Maize Production: Panel Evidence from Uganda

Final Report

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Abstract

With imperfect markets, especially in the credit and labour markets in developing countries, migration and remittances can help to overcome the challenges associated with agricultural production through re-allocation of labour and purchasing inputs among other ways. The paper uses a farm household utility maximizing model to examine the impact of migration on labour supply and the impact of remittances on farm inputs in maize production. The dataset used comes from the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) for the period 2005-2014. Using instrumental variable and fixed effects two stage least squares, the results show that temporary migration affects labour supply—measured by person days—positively, while permanent migration does not. Further, both local remittances and remittances from abroad have a positive effect on maize production mainly through absorbing the cost of hired labour, and in some cases the cost of pesticides, although local remittances have a higher significance. The results show that migration and remittances complement credit but substitute off-farm activities. The results are robust to changes in specifications and different samples.

Key words: Migration, Remittances, Maize, Production, Africa, Uganda

1. INTRODUCTION

Remittance[1] flows from migrants[2] in the low- and middle-income countries (LMCs) are now the most important external funding, overtaking official development assistance (ODA) and foreign direct investment (FDI) (World Bank, 2019). As a result, many governments see migrants as potential investors and actors in economic development in LMCs. Remittances are

[1] "Cross-border, person-to-person payments of relatively low value. These are typically recurrent payments by migrant workers to their relatives in their home countries to cover a substantial part of their daily expenses" (IFAD, 2015).

[2] A migrant according to the UNESCO is the "any person who lives temporarily or permanently in a country where he and she was not born and has acquired some significant social ties to this country". The UN defines a migrant worker as a "person who is to be engaged, is engaged or has been engaged in a remunerated activity in a State of which he or she is not a national" (see http://www.unesco.org/new/en/social-and-human-sciences/themes/international-migration/glossary/migrant/)

considered important for reducing income inequality, poverty and increasing economic growth compared to ODA and FDI (de Hass, 2010). Although international migration[3] is important in LMICs, internal migration[4] is more common and can have more consequences on the local labour market and poverty levels compared to international migration (Boutin, 2018). Internal has however received less attention in the literature and in the policy domain. Recent studies have found that rural-urban migration in LMICs has transformed social relations with families sending these migrants and also changed farming practices and livelihood strategies in many households in the rural areas (Caulfield *et. al.*, 2019; Brauw, 2019). As a result, governments and policy makers see migration and remittances as a strategy for creating food security and reducing poverty in rural areas in developing countries.

Uganda has a history of labour migration attributed in part to instability within the East African region, and recently better social and economic opportunities (Rutaremwa, 2011). Migration to the urban areas by the youth is mainly because of lack of economic activities in the rural areas (FAO, 2017). According to the World Bank (2019), foreign remittance flows in Uganda were $1.2 billion, and Uganda was the 7th largest remittance receiver in Sub-Saharan Africa in 2018. Migration and remittances in Uganda especially in the rural areas can have an effect on agricultural production and productivity especially the smallholder farmers[5] who use low cost inputs, use traditional and labour-intensive farming techniques (Leliveld *et. al.* 2013; Kapri and Ghimire, 2020; Abate *et, al.* 2020) and operate on a subsistence basis. Therefore, migration, remittances and subsistence agriculture in the rural areas are livelihood strategies can help in reducing poverty.

The Ugandan government has prioritised maize production due to its high potential for creating food security given unreliable rains and adverse weather. It also increases Uganda's export earnings[6]. Through programs such as Operation Wealth Creation (OWC)[7], in 2016, the government distributed 14.6 million bags of maize seeds to both commercial and small-scale farmers. The government hopes to produce 10 million tonnes by 2020 and export $105 million

[3] "The act of moving from the country of origin (or of habitual residence) across internationally recognized State borders" (IOM, 2011),

[4]"The act of moving within the country of origin (e.g., from a rural to an urban area) (IOM, 2011)

[5] "A type of farming in which most of the produce is consumed by the farmer and his or her household, rather than being produced for sale." (Uganda, Ministry of Agriculture, animal industry and fisheries, 2013).

[6] In 2018, Maize production was about 3.2 million tonnes and exported about 1.36 million tonnes worth $352.1 million.

[7] Use one acre of your land for cash crop production, one acre for fruit production (for sale), one acre for daily production (for sale) and final one acre for food crop production (Owaraga, 2016).

annually[8]. The Ministry of Agriculture hopes that these programs will result in increased maize production and productivity. The study uses panel data for the period Living Standards Measurement Study (LSMS) for 2005-2014 and the main objective is to examine the impact of migration and remittances in maize production in Uganda. Specific research objectives in this study are: 1) the impact of migration on labour supply involved in maize production, and 2) the impact of remittances on farm inputs used in maize production in Uganda.

The theoretical literature shows that migration and remittances can influence agriculture productivity and production and this relationship is complex (Nguyen *et. al.,* 2019; Brauw, 2019). With the loss of labour force in the farm when household members migrate, remittances from the same migrants can offer a remedy for the loss (Lewis 1954; Taylor, 1999). Remittances can help overcome credit constraints by enabling farmers to accumulate assets and invest in the farm (Adams, 1998). However, such a dynamic may result in overdependence on labour migration and remittances, thus undermining local agricultural livelihoods and exacerbating social inequalities (Lipton, 1980). New Economics of Labour Migration theory (NELM) find that migration reduces labour available in the farm in the short run, remittances from migrating household members may diversify income sources and may also be used to purchase farm inputs such as fertilizer or machinery (Stark, 1991). Such investments have the potential to increase agricultural productivity and production (de Hass, 2010). Further, migration results in labour withdrawal because of better returns from off-farm activities. As a result, farming households cut down on leisure as labour availability contracts, thus affecting agricultural productivity and production if there is no underutilised agricultural labour (Wang *et. al.,* 2014; Brauw, 2019).

However, majority of the empirical studies done in Latin America and Asia show mixed and inconclusive findings. Early studies showed that migration from rural farms led to labour shortages that diminished agricultural productivity and production (de Hass, 2010; Maharjan *et. al.,* 2012; 2013; Tuladhar *et. al.,* 2014). In line with the NELM, other studies in different regions showed that migrants' remittances compensated for labour shortages by providing resources that are then invested in agricultural inputs or hired labour which then increased agricultural productivity and production, or indirectly affect production through mechanisms such as consumption smoothing, investment in education and health or other expenses that

[8] https://www.agriculture.go.ug/agriculture-sector-strategic-plan-assp/

affect farmers' welfare (Taylor & Martin, 2001, Taylor & Lopez-Feldman, 2010; de Haas, 2010; Maharjan *et.al.*, 2013). Apart from these opposing views, there are also studies that show that neither labour migration nor remittances had an impact on agricultural production. In fact, remittances received were not invested in agriculture, but were instead used for household consumption and other expenses (de Brauw and Rozelle 2008; Castelhano *et. al.,* 2016).

In Africa, studies also revealed mixed results; some show that remittances have insignificant and others negative impact on production for instance in Zimbabwe (Mazambani, 1992), Ghana (Akudugu, 2016), Rwanda and Congo (Ochieng *et, al.*, 2016), while others find positive effects, e.g. enabling investment in modern farm implements in Swaziland and South Africa (Simelane, 1995) and Ethiopia (de Brauw, 2014; Abate *et, al.,* 2020). In Uganda, remittances do not result in farmers engaging in risky activities such as crop diversification (Veljanoska, 2014). According to Brauw (2019), migration does not affect agricultural production negatively but households adjust their production patterns and techniques to maintain their average income. In addition, migration is an imperfect substitute for insurance and reduces risks at the household level.

This study makes several contributions as follows. Most of the papers in this area focus on the direct impact migration and remittances of agriculture productivity (for example Rozelle *et, al.,* 1999; Taylor & Lopez-Feldman, 2010; Li *et. al*., 2013) which show a positive impact. However, few studies also show that remittances can affect production enhancement choices in the farm through different ways such as modern farming technology, high yields varieties, hiring labour moving capital intensive input mix. Remittances can also result in income that can remove constraints in credit moving towards cash input intensive mix mainly in Asia and Latin America, which can result in structural transformation (Mendola, 2008; Velosa, 2011; Li *et. al.*, 2013; Wang *et.al.*, 2013, Castelhano *et al.*, 2016). In addition, migration and remittances can also influence prices due to the lower costs of agriculture production which can have distributional and welfare effects (Wang *et.al.,* 2013; Castelhano *et.al.*, 2016). Moreover, the extent to which migration and remittances in this countries or other transfers foster investments and alleviate rural poverty in agriculture as well as the mechanisms are not clear in the empirical literature (Davis and Carr, 2014).This paper extends this literature by looking at the mechanisms through which migration and remittances can influence maize production in developing countries.

Secondly, this paper focuses on agricultural household model using market imperfections, which stresses interaction between credit institutions and households in making migration decisions. In this regard, migration plays the role of financial intermediaries[9] which helps households to overcome liquidity and risk constraints which affects agriculture production and consumption, therefore resulting in non-separable household model, which is prevalent in African countries (Dillion and Barrett, 2017). Therefore, the impact can differ due to context specificity and therefore the paper looks at Uganda where small farmers make the decisions to produce and consume simultaneity and migration and remittances can influence both decisions.

Thirdly, the decision to migrate is a family decision and there could be observable and unobservable characteristics that influence the decision to migrate. Because migration and unobserved factors are correlated, it is not easy to measure the effects of migration on agriculture production. In recent literature, migrants' remittances can be considered endogenous as a potential substitute for income (Howell, 2017). Moreover, there could be reverse causality since agriculture outcomes can influence migration and remittances. There is also a challenge related to separating the effects of both migration and remittances on agriculture production, and to mitigate this challenge, this study uses instruments variables for simultaneous bias. In addition, most of the studies focus mainly on cross sectional analysis using 2SLS and 3SLS methods to estimate the impact of migration, remittances and agriculture production (Miluka *et. al.*,2010; Maharjan *et.al.*, 2012;2013; Tuladhar & Adhikari, 2014; Kapri and Ghimire, 2020). This is mainly due to data limitations (Adam, 2011). The study uses panel data and IV-fixed effects following papers by (Damon, 2010; Chiodi *et.al,* 2012). Moreover, the study also takes in to account the heterogeneity related to migration (temporary vs permanent), remittances (external vs local) and regions in Uganda.

The paper is organised as follows. The next section presents an overview of maize production and remittances in Uganda. Section 3 presents a review of literature on migration, remittances, and agriculture, largely in developing countries. This is followed by the theoretical framework in section 4. The data and empirical strategy are in Section 5. The results and discussions are in section 6 followed by a conclusion in section 7.

[9]There are many reasons why migrants can send remittances to the households in their home countries such as to invest, overcome credit constraints and missing markets.

2. OVERVIEW OF THE AGRICULTURAL SECTOR, MAIZE PRODUCTION AND REMITTANCES IN UGANDA

Uganda, is landlocked country in East Africa. Agriculture is the mainstay of the economy and employs about 82 percent of the population who live mainly in rural areas. It accounts for about 44 percent of GDP and 90 percent of export earnings (Owaraga, 2016; Diiro and Sam, 2015; UBS, 2016). Most of these outputs is comes from smallholder farmers (Sserunkuuma, 2005).

Uganda has implemented various national policies to encourage the growth and productivity of the agricultural sector. Before 2001, policies affecting the sector were not specific though there were significant strides towards the betterment of the sector through, for example, liberalizing the marketing of crops (MAAIF, 2011). In 2001, the country developed the Plan for Modernization of Agriculture (PMA) which was part of the Poverty Eradication Action Plan (PEAP), a plan that involved the collaboration of several ministries towards poverty alleviation. The purpose of the PMA was to enable the agricultural sector to make the shift from subsistence farming to commercial farming. The establishment of the PMA led to the creation of the National Agricultural Advisory Services (NAADS) and the National Agricultural Research Organization (NARO) (Buyinza *et al.*, 2015).

In between 2006 and 2008, the government attempted to improve the standards of living of rural households by implementing the Rural Development Strategy program which included specific activities at the sub-county level which would encourage higher incomes. Later the Prosperity for All Program was implemented to include all households (MAAIF, 2011). Furthermore, the government implemented the Agricultural Sector Development Strategy and Investment Plan in 2010 and another one for the period 2015/16 to financial year 2019/20 whose main objective was to increase incomes in rural homes, improve food security and alleviate malnutrition, agricultural production and productivity and access to critical farm inputs among other areas. The main priority commodities include bananas, beans and maize (Ali *et. al.*, 2016).

2.1 Relative importance of maize in the Uganda

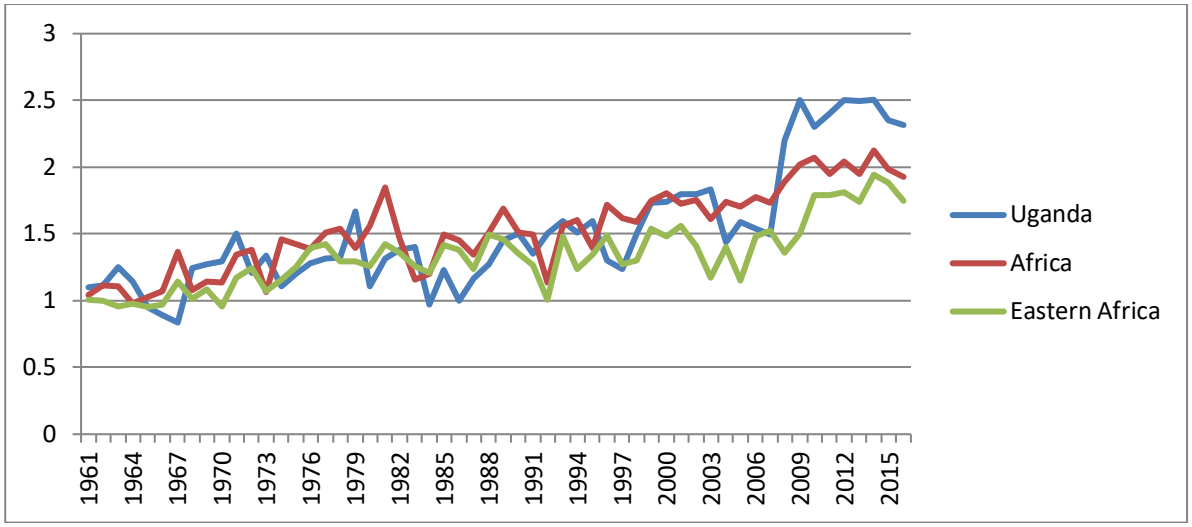
For most of the families in Uganda, maize is the most important food crop due to the large quantity of carbohydrates, proteins, vitamins and fats, contained in the kernels which is an

energy source (Agona *et. Al.,* 2001). Maize has been known to also be used in the production of cooking oil and medicines and this it is a strategic food security crop in Uganda (Okoboi, 2010). The maize crop produced is used for human consumption, but also as feed for livestock and poultry. Maize is grown twice in a year and is inter-cropped with beans, soybeans and groundnuts.[10] 90 percent of the maize is produced by smallholders, of which 60 percent is consumed on the farm. Maize is the source of about half of rural families' cash income (Sserunkuuma, 2005). Whenever an urgent need for cash arises, most farmers sell surplus maize at low prices in the market who then sell maize flour back to the community during the dry seasons at a price several times higher than the original price of the maize grains. This income is not able to cater for the family needs and purchase of farm inputs. In addition, due to lack of post-harvest storage facilities and poor infrastructure, the quality of the product is compromised. Bad handling on maize results in high moisture content which breeds aflatoxins which are harmful when ingested by humans (Tugenhat, 2017).

Production of maize in Uganda has continued to grow steadily over the years as seen in figure 2 below from 1.44 tonnes per hectare in 2004 to 2.30 in 2010, a high of 2.50 in 2014 and has levelled off at 2.32 tonnes per hectare in 2016. The yield has been seen to grow steadily over the years with a significant leap in 2008 while production in the Eastern African region is mostly constant. The yield in Africa is also seen to grow at a steady pace though still seen to be lower than that of Uganda as it is seen to be at 1.93 tonnes per hectare as of 2016. Eastern Africa trails at 1.75.

Figure 2: Yield of Maize in Uganda in t/ha from 2000 to 2016 and compared to other countries in the Eastern Africa region

[10] http://www.yieldgap.org/uganda



Source: FAOSTAT

However, despite the importance of maize to the sector and the general economy, these levels of yield are quite low. The low yields can be attributed to drought, little use of inputs, use of low quality of seeds or those of low yield variety, and disease damage (Wamatsembe *et. al.*, 2017). The maize yield gap in Uganda varies between 6,000kg/ha to about 10,000kgs/ha which is similar to other East African countries. Due to lack of access to irrigation systems, water limited yield gap is about 1,000kg/ha to 4,000kg/ha in Uganda, which depends on soil type and topology in the plot[11].

Additionally, the quality of maize produced in Uganda is thought to be of lower quality as compared to its counterparts, for example Kenya. According to Daly *et. al.*, (2016), the sub-standard quality may be due to financial constraints at farm level resulting in investment in low quality inputs, and the ownership of small-sized farms which cannot deliver economies of scale or use of machinery effectively. In addition, small holder farmers cannot access credit owing to lack of collateral, lack of sensitisation, high interest rates, access in the rural areas among other reasons which make it impossible for most farmers to engage inputs required for increasing agriculture production and productivity (Kinuthia, 2018). The government of Uganda plans to increase maize production and productivity using different methods such as distributing improved seeds, increase access and use of fertilizers and pesticides, use of extension services and mechanization, supporting poor harvest handling, processing and value

[11] ibid

addition[12]. Therefore remittances can be a good alternative through which farmers can purchase inputs and hire labourers to increase agriculture production.

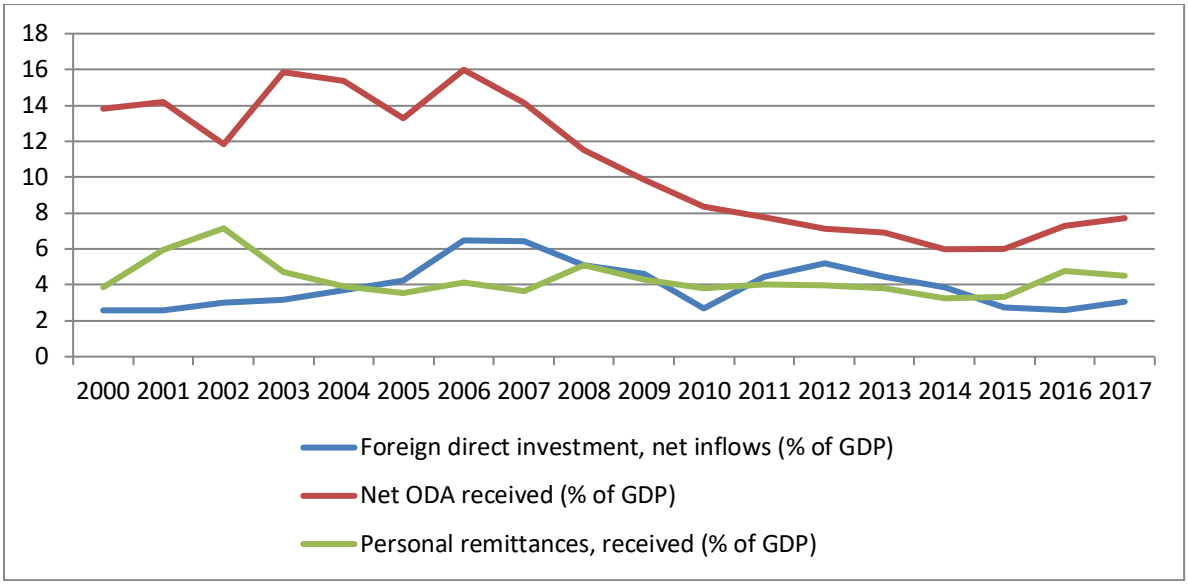
2.2 Migration and remittances in Uganda

In Uganda, about 5 percent of the population are migrants (Mckay and Deshingka, 2014). According to FAO (2017), about 48 percent of the households in Uganda have at least one migrant. In addition, 42 percent of the households have an internal migrant and 11 percent of the households have an international migrant. Migration is a dynamic process and most people move within different regions within the country. Families that can access more funds pay for international migration. Most Uganda nationals that travel outside their home country visit other African countries mainly Kenya, Tanzania and Rwanda respectively in terms of significance (UBS, 2010).

Presently, Uganda's external remittances continue to grow reporting a high of 4.5 percent of GDP in 2016 as shown in figure 3 below, overtaking foreign direct investment in 2014. In addition, official development assistance (ODA) in GDP has reduced from 16 percent in 2006 to below 8 percent in 2017. North America displayed the highest percentage of remittances sent to Uganda at 28%, followed by the Middle East region at 24.9% and the third highest being Europe at 25% (CBU, 2016). According to Central Bank of Uganda (2016), remittances are used by households for consumption (69.8%) and education (27.4%).

Figure 3: External Sources (% of GDP) from 2000 to 2017

[12] https://www.agriculture.go.ug/agriculture-sector-strategic-plan-assp/



Source: World Development Indicators 2018.

The increase in remittances over time has given some policy makers the hope that they will lead into significant developmental gains (Birsdall *et. al*., 2005). In Uganda, the National Migration Policy addresses different issues of development such as diaspora bonds and diaspora banks. However, both the first and the second national development plans for the period 2010-2015 and 2016-2020 respectively do not recognize the role of migration in development. At the moment, the government is developing the National Diaspora Policy which will encourage the diaspora participation national development[13]. According to UNCTAD (2018), African countries can increase the impact of the benefits by ensuring that migration, trade and investment policies are focused on development objectives, using remittances for productive investment, friendly flexible labour policies to ease migration mobility among others to contribute to African development.

3. LITERATURE REVIEW

3.1 Theories related to migration, remittances and agricultural production

There are different theories that conceptualise the impact of migration, remittances on agricultural production and the related mechanisms. Migration can be considered as both internal or domestic, and external or international. External migration in many cases tends to

[13] https://www.mofa.go.ug/data/smenu/16/Overview%20and%20Mandate.html

follow after internal migration because of costs is less by almost a half. When there is a shortage in labour in urban areas, both external and internal migration become substitutes (Clemens, *et. al.,* 2014; Otoiu *et. al.,* 2014). However, there is heterogeneity in migration. Temporary and permanent migration might differ in terms of destinations, education levels, skills, occupations among other factors which can influence the impact on origin countries (Dustmann and Gorlach, 2016; Liu and Xu, 2017).

Using the dual economy framework, migration from the rural agricultural sector to the modern sector takes place due to the prospect of employment and better wages. The migrant decides to move away from home in search of employment to provide security and also to provide for the household an alternative source of income (Lewis, 1954; Harris and Todaro, 1970). The decision to migrate by a labourer is based on pull and push factors such as better opportunities, education and wages in the modern sector. In this case, there is surplus of labour, and thus, the loss of labour in the traditional sector does not reduce farm production. However, migrants could generate new innovations as well as remittances important for development (de Hass, 2010; Nguyen *et. al.,* 2019). Some theories in this area also show that migration has a negative effect through brain drain in host countries. However, literature shows that returning migrants result in overall skill endowment on home countries, compared to permanent migrants (see Boeri, *et. al.,* 2012; Dustmann and Gorlach, 2016). These theories focus on the individual not the households or family, although studies show that migration is a decision made by the family or the households (de Hass, 2010).

Other theories such as the general classical agricultural household model (AHM) which relies on perfect markets and efficiency with the assumption of separation of households consumption and production decisions, shows that the loss of labour due to migration causes farming households to cut down on leisure and other farm activities that yield low returns and then move to new technologies which can influence agriculture productivity and production (Wang *et.al,*2014). Using the utility framework, farming households can be credit constrained due to incomplete markets in the agriculture sector. As a result, remittances from migration helps overcome credit constraints leading to the accumulation of assets by farmers and increased investments in the farm (Adams, 1998). In addition, production choice is not related to consumption and non-farm activities (Wang *et.al,* 2014). However, in developing countries, imperfections and missing markets means that household production decisions are affected by

its preferences such as demographic composition and consumer preferences (Dillion and Barrett, 2017).

According to the New Economics of Labour Migration (NELM), migration is a household decision. Migration is seen as a livelihood strategy which households pursue to diversify income sources to be able to overcome risks and other constraints (de Hass, 2010; Nguyen *et. al,* 2015). Due to incomplete markets in the agriculture sector, there are credit constraints and risks that affect production and productivity (Taylor& Martin, 1999; Velosa, 2011). Like the other theories, NELM considers migration as a permanent phenomenon. Further, the short run effect of migration according to NELM is the loss of labour. In the long term however, migration can result in remittances which can help farmers' investment in, say, inputs and equipment which can help increase agricultural production as well as productivity (Maharjan *et.al,* 2012). In this case, the risk is shared by both the migrant and the household members to whom the funds are remitted. Remittances can however also reduce agricultural production and productivity if labourers or farmers decide to engage in leisure or non-agriculture activities (Sauer *et.al,* 2015).

3.2 Empirical literature

Literature that investigates the relationship between migration, remittances and productivity and production in agriculture has generated mixed results which, according to an extensive review by de Haan (2010), indicate that the effects may be context dependent. Most empirical studies cover regions in Asia and Latin America, and they largely fall into three categories: those that show that migration from rural farms lead to labour shortages that then negatively affect agricultural productivity and production; those that show that migration and remittances increase agricultural productivity and production, and those that show no effects.

The first category of studies aligns with the neoclassical migration theory (de Haas, 2010). For instance, Maharjan *et.al.,* (2012;2013) using two stage least squares method (2SLS), showed that in Western Nepal, households with international migration reduced crop production. A similar study, Tuladhar & Adhikari (2014) using three stage least squares method (3-SLS), found a negative impact of international migration and remittances on the productivity of the agricultural sector. Households receiving the remittance income did not show any improvements in agricultural production. However, Kapri and Ghimire (2020) using 3-SLS,

show that remittances have a positive effect on agriculture productivity in the Terai region and in the mountain regions in Nepal. A case study in Nepal showed that migration resulted in loss of labour in the households but overcomes the loss by using neighbours and hired labour and sometimes reduced area for cultivation (Khanal *et. al.,* 2019). In Albania, remittances by international migrant households have resulted in less hours on the farm by household members, and instead, they put more hours in non-farm economic activities using 2SLS estimator. Females from these homes are seen to work harder than men in comparison with non-migrant households (Miluka *et. al.,* 2010). Similar results are found in El Salvador, where international migrant households were seen to farm less compared to other households and there was re-allocation of resources from cash crops to production food crops using IV-fixed effects model (Damon, 2010).

The second category of studies advance the New Economics of Labour Migration (NELM) viewpoint, where findings indicate that both international and internal migrants' remittances compensated for labour shortages by providing alternative income streams that enable farming households to make capital investments and purchase farm inputs (e.g. Taylor& Martin, 2001, de Haas, 2010; Hull, 2007). In Mexico, Taylor and Lopez-Feldman (2010) show that remittances from international migrants to the United States resulted in improved of crop incomes using the endogenous switching regression strategy. A similar study in Mexico by Chiodi *et.al,* (2012) using OLS, FE, IV-FE and Generalized Method of Moments (GMM) estimators, found that poor families in the rural areas make the decision to invest in productive activities if receiving remittances from international migration. Households comprising of international migrants in rural Bangladesh were more likely to adopt modern farming methods than those with domestic migrants based on IV-Probit and logit models (Mendola, 2008), and in Thailand, households with international migrant remittances were able to plant rice because they could hire agricultural labour (Hull, 2007). In Eduador, temporary rural migration resulted in reduction labour availability while remittances were used on farm inputs, new techniques and increase in crop production using the Structural Equation Model (SEM) (Caulfied *et. al.,* 2019).

Rozella *et. al.,* (1999) in a study of rural China, found internal migration and remittances to have a negative effect on maize yield based on 3SLS estimator. However, in a later study De Brauw and Rozelle (2008) found a significant link between consumptive investments and remittances but no link between increased income and investment in productive activities in

rural China based on IV-FE and GMM estimators. In Vietnam, Migration who send remittances result in reduction of the share of income from rice but increase land productivity. However, migrants who not send remittances result in the loss of farm labour productivity and crop diversification in rural areas based on the village fixed effect estimator (Nyugen *et. al.*, 2019).

The third category of studies fall in the middle ground; they show negligible disparities in productivity between non-migrant-sending and migrant-sending households, while others showed mixed results. For instance, Gray (2009) using multivariate methods, showed that households with out-migration both internal and international did not differ in subsistence maize and bean yield from households without out-migration. Jokisch (2002) in a case study in Ca'nar Province, Ecuador also showed no differences between households that received remittances from international migration versus those that did not have access to remittances in terms of yields. In fact, remittances received were not invested in agriculture, but instead were used for household consumption and other expenses. Similarly, a study in Kyrgyz by Atamanov & Van den Berg (2017) using 2SLS method found that households used remittances to make up for losses of crop income attributed to permanent international migration. Castelhano *et. al*, (2016) further found that remittances from internal migration do not result in the investment in productive activities in the farm in rural Mexico based on the Heckman selection model.

In Africa, studies also revealed mixed effects of migration and remittances on agricultural production and productivity. Some show that remittances have positive effects, while others show insignificant and others negative impact on productivity. Positive effects of remittances on crops income and yields, for instance enabling investment in modern farm implements, were found in Swaziland from international migration to South Africa (Simelane, 1995) and Ethiopia (de Brauw, 2015; Redehegn *et. al*, 2019). However, in Ethiopia, there was a negative effect on crop income and asset accumulation for the permanent migration based on 3SLS estimator (Redehegn *et. al*, 2019). A similar study by Abate *et, al.*, (2020) using the propensity score matching method, found that labour migration helps in income diversification by farmers toward commercialization. A case study in Zimbabwe showed that international migrant-sending households lower farm labour input and lower yield compared to non-migrant-sending households (Mazambani, 1992). Similar results were found in Malawi where migrants resulted in reduction of income from crop production using difference and difference and FE methods

(Jovanovic *et. al,* 2019). In Ghana, Akudugu (2016) shows that the level of remittance given to a household has an insignificant and negative impact on farm size using mixed methods. Zahonogo (2011) show that remittances in Burkina Faso from international migration were used to supplement low agricultural income spent on household consumption needs based on 3SLS method. In addition, migration has a positive effect on yields while a study in Kenya found a positive effect on adoption of improved seeds based on 2SLS and 3SLS methods (Tshikala *et al.,* 2019).

3.3 Gaps in the Literature

Most of the literature on migration, remittances on agriculture production follow the NELM which focuses on the family as a decision making unit. Due to imperect and missing markets, migration is a livelihood strategy to overcome shocks and risks. While, migration can result in loss of labour, remittances can be used in paying the cost of debt used in sending the migrant, its also used in reducing risks and shocks and can also be used for investments. Most of the literature does not distiguish temporary and permament migrants perhaps due to lack of data, but the effects can be quite different and therefore this omission can affect the results significantly. Directly, remittances can overcome the loss of labour by hiring labour which can affect agriculture production. In addition, remittances can influence production indirectly through buying farm imputs.

Empirical literature shows mixed results in all countries surveyed. Whether migration and remittances can effect agiculture production and through which mechanisms is an emprical question. Few studies have been done in Africa compared to Latin and Asian countries due to mainly dataset limitations the impact of migration and remittances on agriculture production is unique for each country. In many developing countries, most countries use cross-sectional data and 2SLS method to analysis the effects due to data limitations. In addition, even when there is panel data available, the is attrition. If attrition is high, estimation can be biased in addition to unobserved chrateristics which is related to migration and agriculture outcomes. Taking care of the problems mentioned, the study uses LSMS dataset for the period 2005-2014 which is panel in nature for Uganda and focusing on Maize is one of the most important crop, migration and remittances can potentially be used to increase agriculture production and therefore directly reducing food security and reducing poverty. The study also takes into account for heterogeneity of migration, remittances and regions in the analysis.

4. THE THEORETICAL FRAMEWORK

In this section the study develops a framework on how migration and remittances can influence the decision to produce in a developing country. Maize in Uganda is produced, and the surplus sold locally or exported too mainly to East African countries such as Kenya. Using farm household model for maize production with labour heterogeneity and non-separability between consumption and production decisions, it is possible to show how labour supply influences the production decision for the farm family (Dillion and Barrett, 2017). The preferences for the family are defined using income (I) and leisure (L) and their utility can be expressed as follows.

$$U = U(I, L) \tag{1}$$

The farmer's production function can be developed as a function of on-farm family labour (F) and hired labour (H) and that they are imperfect substitutes.

$$Q = f(F, H; A) \tag{2}$$

where agricultural production is Q and A is a fixed or exogenous factor such as land. If we assume that 1 and 2 above are twice continuous differentiable, it is possible to assume that each labour input is subject to diminishing returns based on the first difference of the production function. Assuming that the factors' market is competitive, and that labour input is heterogeneous, the unit cost of each input will be w_0 for the off-farm family labour and w_H for the hired labour.

If a household has a time endowment, it allocates time to on-farm work (F), off-farm work (O), leisure (L) and hired labour (H) for each period. With migration (M), the households reduce the time endowment for the different activities. Some of the farmers will be constrained in the labour market because of migration and therefore they might not be unable to invest enough labour in agriculture production and this can be stated as.

$$T = F + O + L + H + M \tag{3}$$

Therefore, the main source of income for the household will be on-farm income (I_F) which comes from farm revenue less wage payment to hired labour because most of small holder farmers sell their crops to be able to take care of family expenses. Other sources of income are off-farm income (I_O), remittances from migrants I and non-labour income such as dividends etc (Z). If p is the price of the products in the competitive market, we can express the total income for the household as follows:

$$I = \{pf(F, \underbrace{H: A) - w_H H}_{I_F}\} + w_O \underbrace{(T - F - L - H}_{I_O} - M) + R + Z \quad (4)$$

We can substitute equation 4 in equation 1 above to get the following equation.

$$U = U(\{pf(F, H: A) - w_H H\} + w_O(T - F - L + H - M) + R + Z), L \quad (5)$$

The householdmaximizes utility by using F, H, and L. Using the first order conditions (FOCs) we can show the marginal products and wages for the farmer as follows.

$$pf_F(F, H: A) - w_O = 0 \quad (6)$$

$$pf_F(F, H: A) - w_H = 0 \quad (7)$$

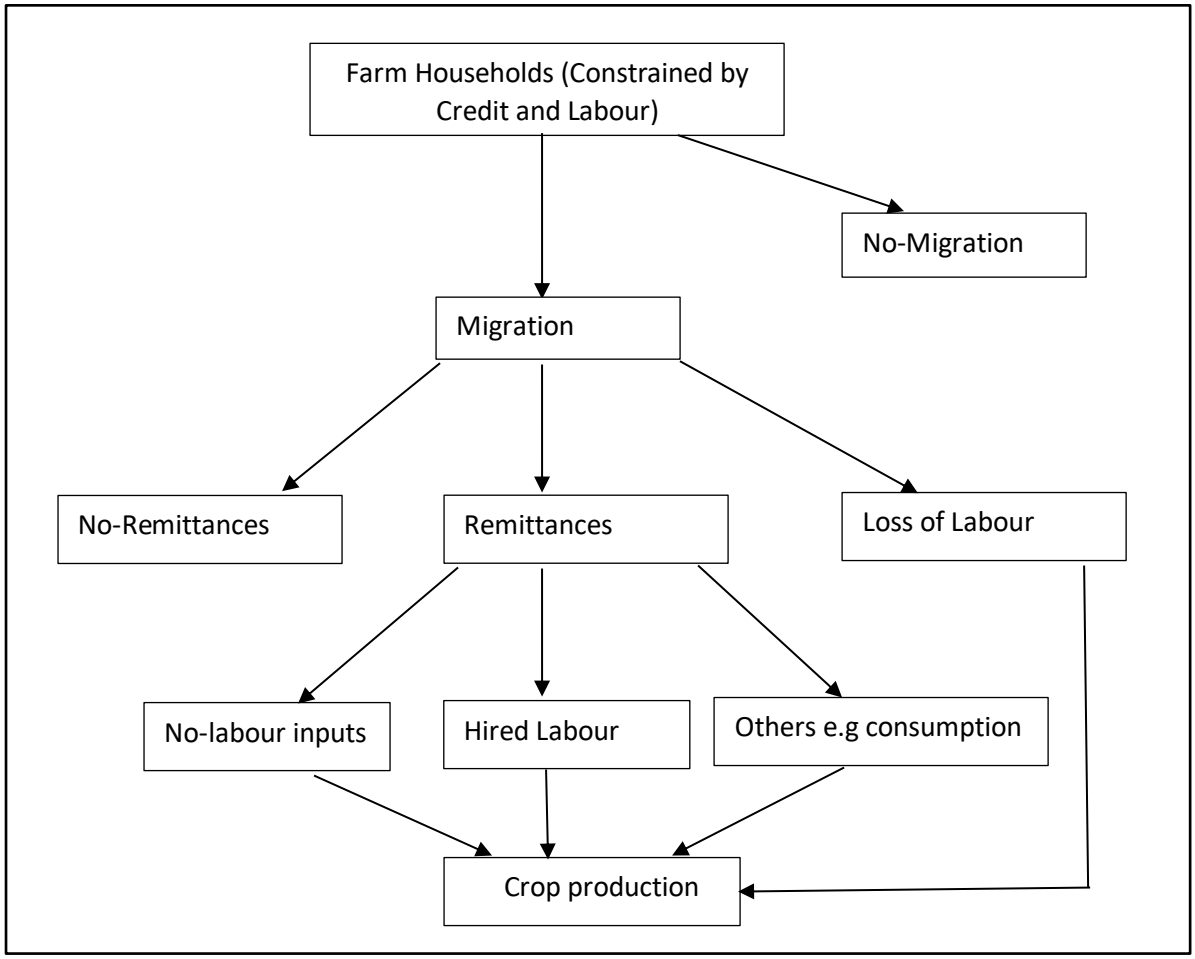
$$U_I(I, L)(-w_0) + U_L(I, L) = 0 \quad (8)$$

The equations here show that the household supplies labour to the farm to the level where the value of marginal product of on-farm labour equals the competitive off-farm wage. In addition, the hired labour is hired to the level at which the value of the marginal product of labour is equal to hiring wage.

If the farmer is constrained in the labour market and the on-farm family labour (F) is scare, then $pf_F(F, H: A) > w_O$. Migration in this case causes labour shortages and therefore reduces agricultural output. However, if the farmer is unconstrained in the labour market, migration will not affect the agricultural output. Similarly, if the farmer is constrained in the credit market, remittances affect agricultural output as the farmer can hire labour which is the direct effect or indirect through agricultural inputs such as seeds and fertilizers. In addition, remittances can

affect agricultural output through reducing and improving the capacity to cope with risks and can therefore be considered as insurance for the farmer, which is similar to off-farm activities. Remittances can also affect agricultural production indirectly through part or full spending on household activities and can also influence spending that can result in an increase in agricultural production through smoothing consumption, health and education as shown in figure 3 below. In Uganda, most of the remittances go towards consumption, health, and education for the households of the farmers (Rutaremwa (2011; Mushomi *et al*. 2017). The welfare of the farmer determines the availability of the of-farm labour supply in the farm which influence production (Adam, 2011).

Figure 3: Impact pathway of Migration, remittances on Agricultural production



Source: Author's observation from the LSMS datasets for Uganda

5. DATA AND EMPIRICAL STRATEGY

5.1 Empirical Strategy

In this section the study developed the models that will be estimated. The first model estimate the impact of migration on labour participation in maize production in Uganda. Second, estimate the impact of remittances on farm inputs in maize production in Uganda.

5.1.2 Impact of migration on labour participation in maize production in Uganda

To estimate the impact of migration on labour participation in the maize production in Uganda, the following estimation is used.

$$y_{ijt} = \alpha_0 - \rho_i M_{ijt} + \beta_i X_{ijt} + \mu_i + \gamma_t + \varepsilon_{ijt} \quad (9)$$

where household is *i, j* is the region and the time is *t* in a panel dataset. Y_{ijt} represents the variable for maize labour supply in Uganda which is the person days of family labour, hired labour and total labour days involved per plot[14]. M_{ijt} is migration for the households each year. Both internal and external migration can reduces the labour available in the family when they are substitutes for non-migrants in the household production. However, if migrants are complements in households' production, it can result in increase in labour supply in the labour market. In Uganda, internal migration is more important than external migration due to rural to urban migration due to prospects of jobs and better wages in urban centres (Boutin, 2016). In addition, temporary migration and permanent migration can have different effects on labour supply in maize production in Uganda. X$_{ijt}$ are households characteristics such as age, gender, area of the plot, livestock etc based on the review of literature. The coefficients in this model are $\alpha_0, \rho_i, \beta_i, \mu_i$ to take care of regional effects and γ_t for the time effects. ε_{ijt} is the error term.

5.1.3 The impact of remittances on farm inputs in Maize production in Uganda

In the second model, the study estimates the impact of remittances on farm inputs in maize production per household. The farm inputs considered include cost of seeds, cost of manure, cost of fertilizer, cost of pesticide and cost of hired labour per plot. The estimating equation is as follows:

$$y_{ijt} = \alpha_0 + \sigma_i R_{ijt} + \beta_i X_{ijt} + \mu_i + \gamma_t + \varepsilon_{ijt} \quad (10)$$

[14] Labour (family and hired) tasks include land preparation and sowing, input application, weeding and pruning, harvesting, etc.

y_{ijt} represents the farm inputs per plot and R_{ijt} is the remittances for the households each year from both temporary and permanent migrants. Remittances sent to the households (both internal and external) can reduce liquidity constraints which can affect the output from the farm. Though, this is not always the case, as members of the household could substitute work for leisure. In addition, the interaction between credit and remittances as substitutes for financial capital investment in agricultural inputs, as well as off-farm income and remittances as a way of diversifying income sources will be examined. Thus, Remittances can be a substitute to credit. The coefficients in this model are $\alpha_0, \delta_i, \beta_i, \mu_i$ to take care of regional effects and γ_t for the time effects. ε_{ijt} is the error term.

5.2 Estimation issues.

Using equation 9 and 10 above, OLS yield biased results since M_{ijt} and R_{ijt} might be endogenous. Migration and remittances are not random process, and there might be unobserved characteristics that might affect the output of farmers. In addition, there can be reverse causality because agricultural practices can influence migration and remittance decisions. Moreover, migration, remittances and maize production decisions might be jointly determined if the households jointly allocate labour and production resources such as land, livestock, etc to send labour to urban centres or abroad. Although the study uses OLS, random and fixed effects models for the estimations first, the results are considered baseline results and cannot be relied upon due to the issues discussed above. To take care of endogeneity and simultaneous biases, we use (2SLS) fixed effects.

Instruments are used for identification purposes related to M_{ijt} and R_{ijt}. Several papers use the number of the students in the households and the average education levels of the migrants. Households that have students might send some of the members to urban areas or abroad to take care of the education of their dependents at home. The average education levels of the migrants can influence remittance levels but directly relates to maize production. These variables are used by Li *et. al.*(2013). Other instruments used by Rozella *et. al.*(1999) include member with the highest level of education, village enterprise, experience and wage which is correlated with migration network among other variables (Li *et. al.*,2013). In this study, we use both family and community networks as instruments. The number of people in a community with migration experience can influence the decision to migrate. In addition, family networks

can influence migration due to social capital and can reduce costs of migration (see Mendola, 2008; Chang *et. al.* 2011, Tshikala *et. al.*, 2019). The study also uses proportion of household members that left the home to look for work and other income reasons excluding the household to which individual belongs to in the village is related to remittances but not the a direct effect of the time allocation as used by Chang *et. al.* (2011).

Using household panel, there is always the issue attrition, i.e. where household or individual members are selected for re-interview but cannot be located or refuse to be interviewed. In the next section, I show all the households that were involved in maize cultivation for the entire period. For the panel estimation, I remove all the households have been recorded once in the entire period. Therefore the estimations are based on the households that recorded at least two waves in the entire period. The some of the variables such as sales and expenditures in the dataset are deflated using consumption price index. The variables used in the empirical estimations are described in Table 1 below.

Table 1: Variable definitions

Variable	Variable definition
Outcome variables	
Total production	Output per plot in kgs
Remittances	Amount in local currency for both cash and kind (both local and abroad)
Migration	Number of members who migrate to urban or abroad
Household characteristics	
Gender	Dummy: 1 if household head is male; 0 if female
Age	Age of household head in years
Formal education: Household	Formal education: Household Head
Household size	Number of household members
Dependency ratio	The ratio of the head of the household divided by household size
Family Labour	Dummy: 1if household have members of the household involved in farming,
Location	Dummy: 1 the households live in the Urban centers, 0 if otherwise
Married	Dummy:1 the head of the household is married, 0 if otherwise
Productive characteristics	
Title	Dummy: 1 if plot owner has a title; 0 if otherwise
Soil type	Dummy: 1 if soil is classified as fair and good, 0 if otherwise
Topology	Dummy: 1 if land is flat or gently slopy, 0 if otherwise
Farm size	Land holding in acres
Assets	Number of household assets
Credit	Dummy: 1 if household received credit, 0 if otherwise
Extension services	Dummy: 1 if household received extension advice; 0 if otherwise
Hired labor	Dummy: 1 if household hired farm labour; 0 if otherwise
Wages	Amount of different activities in local currency
Cost of inputs	Amount of different inputs such as fertilizers, seeds pesticides e.t.c in local
Shocks	Dummy: 1 if agricultural or household shocks occurred; 0 if otherwise

5.2 Data and descriptive statistics

The data used in this study is obtained from Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) from the World Bank for Uganda. The survey sample

contains social and economic data on households which were interviewed in 2005/2006, 2009/2010 and 2013/2014. The study uses a representative sample with respect to the national, urban/rural and main regional levels. We focus on 3 waves because 2010/2011 and 2011/2012 were not compatible with the other waves especially with regard to remittances variables. Table 2 below shows the full sample and the number of households involved in agriculture. The survey shows that most of the households are engaged in agriculture, with more than 75 percent of the households involved in farming. Most of the farmers are involved in maize cultivation, although there has been a decline from 74.6 percent in 2006 to 65.5 percent in 2014.

Table 2: Households: Full sample and engaging in Agriculture

Year	Total	Agri-HH	% of HH in Agri	% of Maize-HH
2005/2006	3123	2348	75.2	74.6
2009/2010	2975	2428	81.6	69.2
2013/2014	3119	2495	80.0	65.5

Source: Author's calculation from LSMS World Bank dataset.

The households come from four regions in Uganda as shown in table 3 below. 25 percent of the households come from the Central region while 28.9 percent of the households come from the Eastern region. 24.08 percent come from the Northern region while Western region account for 21.75 percent of the households in the study.

Table 3: Maize farmers in different regions

Year	2006	2009	2013	Total	%
Region					
Central	411	420	445	1,276	25.19
Eastern	500	488	480	1,468	28.98
Northern	429	437	354	1,220	24.08
Western	412	335	355	1,102	21.75
Total	**1,752**	**1,680**	**1,634**	**5,066**	**100**

Source: Author's calculation from LSMS World Bank datasets

In table 4 below, the study shows the number of households that grow maize, the number of person days households use each year in the cultivation of maize per plot and the number of

person days used for hired labour. The table shows that family labour is more important than hired labour in maize cultivation. There is a fluctuation in terms of the person days used by the households in different areas. However, the table shows that on average person days for family labour is 253 compared with 28 person days for the hired labour per plot.

Table 4: Households: Persons days in Maize production per plot

Year	Households	Family Labour days	Hired Labour days	Total labour days
2005/2006	1,752	222.6965	26.5817	249.2782
2009/2010	1,680	275.4226	45.52202	320.9446
2013/2014	1,634	274.8054	14.41738	289.2228
Totals	5,066	253.9562	28.93923	285.9282

Source: Author's calculation from LSMS World Bank dataset.

5.2.1 Maize production and migration

In terms of migration, households that cultivated maize have many members are involved in temporary migration compared to permanent migration as shown in table 5 below. In 2009/2010 there was more migration with many permanently moving to other area perhaps due to war or terror although in the questionnaire it was only indicated as other reasons. The study shows that 42.9% of the households had a member migrating due different reasons such as looking for work, marriage, education among other reasons. In this study, we focus on whether the household had a migrant in time *t* without focusing on the reasons for migration.

Table 5: Maize farmers and migration statistics.

Year	**Households**	**Migration**	**Temporary Migration**	**Permanent Migration**	**% Migration**
2005/2006	1,752	663	622	41	37.8
2009/2010	1,680	838	722	116	49.9
2013/2014	1,634	672	635	37	41.1
Total	**5,066**	**2,173**	**1,979**	**194**	**42.9**

In table 6 below, shows that households that members migrating more person days for both family and hired labour compared to households whose members did not migrate. This can be expected because in many developing countries there is surplus labour in the rural areas and therefore some of the members can consider looking for work in the urban areas. Therefore we would not expect a negative effect on maize production.

Table 6. Households-Person days in the Maize production per plot

Households	Family Labour	Hired Labour	Total Labour days
Migration	282.4	40.5	325.9
No-Migration	232.6	20.3	255.9
Total	**254.0**	**28.9**	**285.9**
Mean comparison test	6.97***	2.62***	6.56***

In table A1 in the appendix, households with members that seem to be wealthy compared to households whose members do not migrate. The head of the household for the households with members migrating has better education, higher size of the household, marriage and leave in urban areas compared to the households whose members don't migrate. In terms of productive assets, households with migrant tend to have more title of their plots, more assets and livestock, credit and with more networks compared to households that do not migrate. They also grow inter-copping of maize and other crop such as beans compared to the households that do not migrate.

5.2.2 Remittances and Maize production.

Table 7 shows the number of households that receive remittances from sources locally and abroad. In 2006, 40 percent of households surveyed received remittances, compared to 30 percent in 2010 and 27.4 percent in 2014. Most remittances come from local sources and few from abroad.

Table 7: Remittances sent to the Households in Uganda

2006	Remittances	Local	Abroad	Total	%
	Yes	1197	83	1246	40.1
	No	1911	3014	1862	59.9
	Total	**3108**	**3097**	**3108**	**100**
2010		**Local**	**Abroad**	**Total**	**%**
	Yes	842	69	882	30.0
	No	2097	2870	2057	70.0

	Total	**2939**	**2939**	**2939**	**100**
2014		**Local**	**Abroad**	**Total**	**%**
	Yes	798	87	854	27.4
	No	2318	3030	2263	72.6
	Total	**3116**	**3117**	**3117**	**100**

Source: Author's calculation from LSMS World Bank dataset.

In table 8 below, shows the amount of remittances both cash and kind for both local and abroad for the households cultivating maize in Uganda. Both cash and kind remittances are important in Uganda. Although cash remittances are most common, kind remittances account for about 40 percent of the local and about 28 percent external remittances respectively. There has been an increase in local remittances from about 198,204 in 2006 to 694,720 in 2013 which is almost 350 percent increase, while abroad remittances has increased from 663,000 in 2006 to 755836.7 in 2013 which is about 14 percent increase. Although local remittances are important for the households cultivating maize given the number of households involved, the amounts are not as large compared to external remittances although few households involved. Therefore, it would be expected that households that have external remittances will have a greater impact on maize production compared to local remittances.

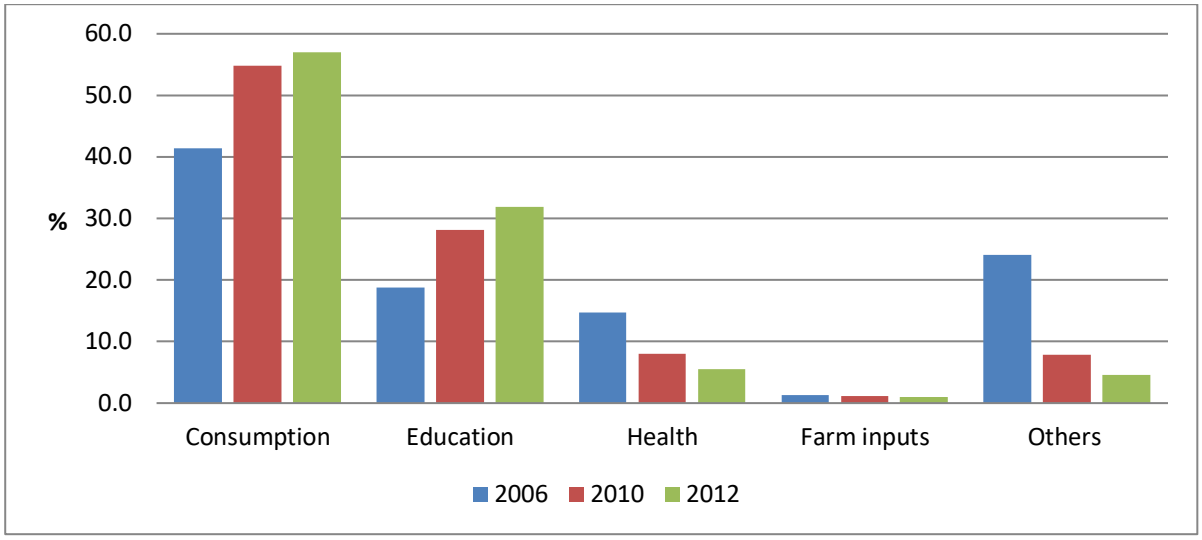
Table 8: Remittances for the households cultivating maize in Uganda (Ushs).

Year	**Local remittances (mean)**			**Abroad remittances (mean)**		
	Cash	**Kind**	**Total**	**Cash**	**Kind**	**Total**
2006	191752.5	84873.51	198204	686106.1	153119	663000
Total	486	504	680	33	21	39
2009	340957.5	170606.4	407184.8	586520.8	360000	681351.9
Total	411	329	482	24	12	27
2013	550127.2	268176.3	694720	726217.4	165000	755836.7
Total	415	300	444	46	22	49
Average	**351850.6**	**158304.2**	**397448.3**	**680815.5**	**203009.1**	**706865.2**
Total	**1,312**	**1,133**	**1,612**	**103**	**55**	**155**

Source: Author's calculation from LSMS World Bank dataset.

Most of the remittances are channelled into different activities in farming households as shown below in Figure 4 below. Most of the remittances are used for consumption by the household and this has increased from about 40 percent in 2006 to 58 percent in 2014. This is similar to Rutaremwa (2011) and the Bank of Uganda report (Mushomi *et al*. 2017), where respectively, 69.8 percent and 55 percent of remittances are spent on expenses such as food, clothing, rent and other utilities.

Figure 4: Use of remittances in the households in Uganda



Source: Author's calculation from LSMS World Bank dataset.

Within the sample, the second most important use of remittances by the households is education. In 2006, 18 percent of the remittances were used in education purposes but this has increased to more than 30 percent in 2014. Similar findings are reported by Rutaremwa (2011) and the Bank of Uganda (Mushoni*et al*. 2017). The other important use of the remittances is health in the households. In the same survey, 15 percent of the remittances were used by the households in health-related expenditure. However, there has been a decline in the use of remittances in health to almost about 5 percent by 2014. Other uses of the remittances among households in Uganda include weddings, building households and funerals. Very little remittances are used in farm inputs which implies that remittances will likely affect maize production through indirect effects through for example hired labour.

In table A2 in the appendix, there are distinct feature of households that receive remittances compared to the households that don't. For household heads that use remittances, the mean age is 41 years, while the household head that does not receive remittances is on average 35 years

old. In addition, households that get remittances tend to be headed by females with lower levels of education and many are not married. They also have small household size and less total labour days compared to households that do not receive remittances. Most of the households live in the rural area but those that receive remittances live near urban areas compared to those that don't.

In terms of productive assets, households that receive remittances have lower maize production and farm inputs compared to those that not use remittances. In addition, the households that receive remittances have smaller plot size, poorer soil type, assets, sales and other incomes. Moreover, in addition, most are not involved in off-farm activities compared to the households that do not get remittances. Table A2 also shows that households that use remittances have more shocks and tend to inter-crop maize with other crops more compared to those that do not receive remittances. In summary, farmers that receive remittances tend to be more vulnerable and poorer compared to those who do not get remittances.

6. ESTIMATION RESULTS AND DISCUSSION

In this section, the paper estimates equations 9 and 10. For the panel estimation, we remove households that recorded once in the dataset as shown in table 9 below. In 2013, 696 cannot be included in the panel dataset since they were new additions in the dataset in column 3. I estimate 9 and 10 models using the full sample i.e 0 (households that were included once in the dataset), 1 (households that were recorded twice in the dataset) and 2 (which are the households that were recorded in all the years) combined, then 1 and 2 and lastly 2. This is important for robustness tests.

Table 9: Duplicates in Households in Maize cultivation in Uganda

Year	0	1	2	3	Total
2006	409	817	526	0	1,752
2009	326	829	525	0	1,680
2013	169	242	527	696	1,634
Total	904	1,888	1,578	696	5,066

Source: Author's calculation from LSMS World Bank dataset.

6.1 The impact of migration on labour in Uganda.

In equation 9, the study estimate the impact of migration on total labour days, family labour days and hired labour days. Family network and migration experience are used to instruments for migration. In table A3 in the appendix, the instruments are valid. Using the two combination

are exogenous based on the Durbin and Wu-Hausman tests and the minimum eigenvalue statistic 6.45 and 12.00 for combined instruments and migration experience respectively which are significant using the F test. In table 10 below, results from different estimations are presented. First, the baseline is based on the instrumental variable regression. It is followed by the random effects in column 2 and the fixed effects model in column 3. The results show that the random effects model is better based on the Hausman test which is 1.40 which is not significant. Based on the random effects, estimations in based on different sample sizes. In column 4, the estimates is based on at least two observations of the households in the entire sample while in column 5 the estimates where the households were recorded in the 3 waves. The estimates in columns 3 and 4 have a good fit and the coefficient of determination is between 17 to 30 percent.

The results show that migration due not influence total labour person days for the entire period significantly although it's positive. The important basic household characteristics that influence total labour person days are education, size of the household and location. Household heads with higher levels of education are able to make informed decisions which affect decisions on labour availability in the farm. This variable is positive and significant at the 5 percent level in most of the estimations. Size of the household determines the number of workers available in the farm and it's significant and positive at the 1 and 10 percent levels in column 4 and 5 respectively. The location of the household determines if there is enough labour to be engaged in the farm. While, the household can be able to engage more people in the farm it might not be the case in the urban centres due to alterative jobs available. This variable is negative and significant at the 1 percent level.

The productive characteristics that influence total labour person days are inter-cropping of maize, title, sales, livestock and off-farm activities. With inter-cropping of maize with other crops requires more labour per plot. This variable is positive and significant at the 1 percent level. The title of the plot gives ownership and this can be used for collateral in case of funds required to pay labour. This variable is positive and significant at the 10 percent level. Similarly, with more sales there is funds available to pay labour therefore possible to engage more labour. Sales variable is positive and significant at the 1 percent level. Livestock is also an important for influencing total labour person days.

Table 10: The impact of migration on Total Labour Person Days in Uganda										
	IV Regression (Total sample)		Random Effects		Fixed Effects		Random Effects (1)		Random Effects (2)	
Variables	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Migration	18.94*	11.56	20.02	16.55	16.58	20.67	7.78	8.71	10.81	16.09
Basic Household characteristics:										
Age	-0.82	1.21	1.29	1.35	1.67	1.71	-0.13	1.07	1.14	1.57
Age Squared	0.02	0.01	-0.01	0.02	-0.02	0.02	0.01	0.01	-0.01	0.02
Education	34.00**	15.56	29.71*	18.13	27.08	23.98	30.59**	12.46	14.05	23.22
Size of Households	9.37	7.68	9.29	10.88	12.22	12.85	18.84***	5.77	17.65*	9.45
Location	-69.78***	17.74	-49.19*	29.22	-19.33	48.27	-77.60***	15.25	-58.35**	25.07
Production characteristics:										
Assets	1.52	1.08	1.17	1.01	1.10	1.21	1.28*	0.73	0.35	1.95
Plot	1.99	3.08	1.54	2.99	1.24	3.79	1.65	2.22	-0.78	3.22
Inter-cropping	1.35***	0.28	0.96***	0.27	0.90**	0.38	1.10***	0.21	1.35***	0.34
Title	37.86**	17.36	48.25**	19.83	46.05*	25.06	34.95***	14.08	27.59*	16.94
Livestock	71.87***	15.43	53.95***	14.64	45.02***	17.39	49.87***	11.08	31.68**	13.69
Sales	0.00***	0.00	0.00***	0.00	0.00***	0.00	0.00***	0.00	0.00***	0.00
Off-farm activities	-38.59***	11.95	-25.19**	12.08	-22.31	15.37	-44.81***	9.79	-39.45***	13.39
Other characteristics										
Credit	28.90*	15.33	25.65*	13.55	22.37	16.97	17.47	11.74	10.11	18.76
Extension Services	40.05**	16.24	48.44***	14.94	46.56**	20.19	34.42	12.66	30.68	23.22
Family Networks	39.49***	14.84								
Regions: Central	70.24	83.86	32.53	125.32	-139.68	325.85	-25.07	138.67		
Eastern	54.37	80.16	28.19	122.07	-254.78	331.87	-35.09	137.08	-18.34	27.40
Northern	39.34	83.10	11.76	126.37	-52.34	523.00	-77.86	136.90	-52.15	37.35
Western	88.58	79.19	54.65	120.81	287.08	580.42	-15.32	135.56	47.73	52.43
Years 2009	7.96	30.79	-2.57	46.70	5.66	61.97	36.63	25.73	81.77*	49.75
2013	36.17*	18.93	52.23***	18.92	48.25**	24.70	55.43***	16.63	77.95***	22.61
Constant	-80.29	87.83	-57.56	129.55	35.10	323.97	26.67	142.16	-20.98	39.57

Totals	5016	4370	4370	3,466	1578
Groups		2,374	2,374	1,470	526
R2-Between		0.0268	0.014	0.2584	0.3004
-Overall		0.03	0.02	0.1699	0.1699
Hausmann test		1.24	1.00		

Note: Statistical Significance at 1% (***), 5% (**) and 10% (*) confidence levels.

Table 11: The impact of temporary and permanent migration on total labour person days in Uganda (Random effects)

Variables	**Full sample**	**1**	**2**		**Full sample**	**1**	**2**
Temporary Migration	28.47***	15.74**	24.94**	Permanent Migration	-19.52	-487.91	-1840.70
	(10.76)	(7.42)	(10.56)		(828.29)	(524.60)	(1267.04)
Region	Yes	Yes	Yes	Region	Yes	Yes	Yes
Year	Yes	Yes	Yes	Year	Yes	Yes	Yes
Total	4,370	3,466	1578	Total	4,370	3,466	1578
No of groups	2,374	1,470	526	No of groups	2,374	1,470	526
R2	0.064	0.2378	0.2891	R2	0.1337	0.1982	0.0646

Note: Statistical Significance at 1% (***), 5% (**) and 10% (*) confidence levels. The controls are as in table 9 above.

Livestock can be used for ploughing, can be sold to get funds to pay workers and for manure. This variable is positive and significant at the 5 percent level. Lastly, availability of off-farm activities reduces the labour available in the farm if the wages offered are competitive. This variable is negative and significant at the 1 percent level.

In table 11 above, there is an estimation of equation 9 using both temporary and permanent migration. Using the different sample sizes the results show that temporary migration results in positive effect on total labour person days in Uganda. However, permanent migration does not affect total labour person days. This is similar to literature that shows that permanent migrants do not much effect on development outcomes such as labour engagement (Boeri, *et. al.,* 2012; Dustmann and Gorlach, 2016). According to the estimations, temporary migration results in an increase in total labour days by about 15-28 person days. Similarly results are shown in table 12 below where temporary migration affects family labour persons days positively and significantly at the 1 percent level in column 2, which considers households that were recorded in all the years in the period of analysis.

Table 12: The impact of migration on Family Labour person days

	Full sample	1	2		Full sample	1	2
Migration	5.25	3.01	10.17	Temporary Migration	8.53	10.87	24.49***
Standard errors	(8.99)	(7.88)	(15.59)	Standard errors	(6.30)	(6.81)	(10.33)
Total	4,370	3,466	1,578	Total	4,370	3,466	1,578
Groups	2,374	1,470	526	Groups	2,374	1,470	526
R2	0.21	0.27	0.27	R2	0.22	0.22	0.25

Note: Statistical Significance at 1% (***), 5% (**) and 10% (*) confidence levels. The controls are as table 9 above.

The results show that there is surplus labour in the rural areas and that temporary migration is not a bad idea as they complement the household production (de Hass, 2010; Nguyen *et. al.,* 2015). However, this is contrary to studies that show that temporary migration reduces labour available (Caulfied *et. al.,* 2019 ;Tuladhar & Adhikari 2014). The impact of migration on hired labour person days is not significant and I don't report that results here.

6.2 The impact of remittances on farm inputs and Maize production in Uganda

In this section the study estimates equation 10 for different kinds of inputs namely cost of seeds, cost of manure, cost of fertilizer, cost of pesticides and cost of hired labour.

Table 13: The impact of farm inputs on Maize cultivation in Uganda

Variables	Cost of Pesticides per plot						Cost of Hired Labour per plot					
	Total Remittances		Local Remittances		Abroad Remittances		Total Remittances		Local Remittances		Abroad Remittances	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Remittances	0.03*	0.02	0.04*	0.03	0.09*	0.05	0.26***	0.09	0.38**	0.15	0.80***	0.27
Size of Households	11.34	245.63	-39.94	291.08	113.55	213.31	1350.90	1441.85	528.83	1884.12	3096.26***	1177.18
Assets	176.48	120.63	173.18	128.20	167.89	122.85	3855.39***	721.98	3909.82***	821.56	3739.81***	750.73
Plot	536.96*	293.01	599.02*	320.91	443.51	282.37	5691.66***	1751.91	5906.05***	2040.34	5236.49***	1742.66
Inter-Cropping	-4.81	26.02	-3.57	28.33	-16.95	26.28	139.91	154.92	176.65	179.57	61.92	158.17
Title	5151.91***	1777.60	5593.75***	1817.28	4428.00**	1964.92	-7120.24	10591.27	-3156.72	11521.67	-15535.29	12377.98
Off-farm	935.46	1165.45	1158.94	1276.24	334.48	1153.84	8021.07	6787.96	10423.67	7963.23	2920.07	6934.86
Credit	-287.51	1407.14	-223.71	1507.83	25.96	1368.96	4203.91	8243.47	4144.15	9523.42	4330.79	8295.96
Livestock	-880.83	1296.54	-1220.27	1490.35	-93.90	1186.52	-20511.22***	7628.33	-23926.60***	9427.51	-13259.95*	7071.27
Sales	0.01***	0.00	0.01***	0.00	0.01***	0.00	0.07***	0.00	0.07***	0.00	0.07***	0.00
Total production	0.00***	0.00	0.00***	0.00	0.00***	0.00	0.01*	0.00	0.01*	0.00	0.00	0.00
Extension Service	-21.41	1759.65	-694.45	2118.06	730.13	1566.56	14092.32	11950.23	9190.52	15146.19	24499.43***	10046.45
shocks	-1008.02	1296.88	-1168.64	1384.74	-886.34	1289.95	1302.46	7702.57	527.37	8813.24	2948.08	7936.51
Central	19358.10**	8398.90	22824.62**	10222.30	11453.14	7078.99	61624.47	47427.26	93580.76	62187.89	-6222.61	41032.29
Eastern	13376.96	9464.27	18518.78	12376.77	1849.23	7080.70	83579.22	52896.86	131490.50*	74583.46	-18142.21	41056.62
Northern	13390.36	9854.32	18434.28	12779.68	2126.42	7141.97	99043.77*	54894.85	145888.70*	76941.39	-413.62	41378.99
Western	13641.94	9766.68	18601.56	12733.90	2136.29	7106.05	114462.90**	54249.10	162282.90**	76405.19	12935.34	41158.16
2009	3526.07**	1434.89	3193.13**	1537.37	4324.79***	1561.94	32014.64***	9114.42	28151.38**	10255.96	40216.81***	10245.35
2013	-3679.99*	2147.71	-5175.72*	2887.44	-405.08	1599.10	-23522.79**	11676.61	-36206.22**	16658.65	3405.69	10492.55
Constant	-17667.82*	9716.91	-22550.53*	12536.48	-6067.17	7204.46	-123360.40**	53552.31	-167999.10**	74192.19	-28586.96	41988.47
Total												
Group	4,370 1,234		4,370 1,234		4,370 1,234		4,370 1,234		4,370 1,234		4,370 1,234	
R2	0.0370		0.1494		0.1494		0.1494		0.1077		0.1221	

Note: Statistical Significance at 1% (***), 5% (**) and 10% (*) confidence levels.

The study uses members of the households' reason for migration for work and other income reasons as in instrument for remittances. The results of this instrument is show that this variable is valid as shown in table A3 in the appendix. This variable is exogenous based on the Durbin and Wu-Hausman tests and the minimum eigenvalue statistic 23.22 which is significant using the F test. The estimates focus on total remittances, local remittances and abroad remittances. The results are in table 13 below using random effects panel model. Only results from presented cost of pesticides and the cost of hired labour due to significance of remittances.

There results show that remittances affect cost of pesticides in the different models based on the type of remittances. Remittances have a positive effect and significant at the 10 percent level. For the cost of hired labour, total remittances affect it positively and significantly at the 1 percent level. In addition, abroad remittances have a significant on cost of hired labour compared to local remittances when focusing on the full sample. The side of the plot is positive and significant in all estimations although it's more significant at the cost of hired labour. With large plot the cost of pesticides and hire labour is expected to be high. The sale of produce is positive and significant in all the models at the 1 percent level. With more fund, it's possible to buy pesticides and also hire more labour. In the cost of pesticides model, title and total production are positive and significant at the 1 percent level. Ownership of the plot and total production of maize influences determines the extent to which a households can consider buying pesticides. In the cost of hired labour estimations, assets are positive and significant at the 1 percent level. Households with more assets can afford to hire more labour compared to households that have less wealth. The results also show that livestock substitute hired labour. Households with more livestock have lower need for hired labour. This variable is negative and significant at the 1 percent level. The size of the households and extension services tend to be more important for the households that receive external remittances. These variables are positive and significant at the 1 percent level.

The impact of remittances is similar for all samples as shown in table 14 below. However, abroad remittances are not significant when the sample focuses on the households that were recorded in the entire period. There results show that local remittances are more important for maize production in Uganda due to their effect on the cost of hired labour. The results are similar to NELM studies such as Mendola (2008) and Hull(2007) in Bangladesh and Thailand, where households were able to hire agricultural labour, which results in increase on production.

Table 14: The impact of remittances on cost of hired labour in Uganda.

Variables	1	2	Variables	1	2	Variables	1	2
Remittances	0.39***	0.27**	Local remittances	0.60***	0.31*	Abroad Remittances	1.15***	2.50
	0.12	0.14		0.24	0.17		0.34	1.60
Total	3466	1,578	Total	3466	1,578	Total	3466	1,578
Group	1470	526	Group	1470	526	Group	1470	526
R2	0.13	0.11	R2	0.08	0.06	R2	0.12	0.07

Note: Statistical Significance at 1% (***), 5% (**) and 10% (*) confidence levels. The controls are as table 13 above.

7. CONCLUSION

The paper examined the impact of migration and remittances on Maize production in Uganda. The first objective was to estimate the impact of migration on labour involvement in maize production. The second objective was to estimate the effect of remittances on farm inputs used in maize cultivation. The study focused on the period 2005 to 2014 using LSMS survey datasets and used 2SLS random effects model to estimate the relationship between migration, remittances and maize cultivation in Uganda.

The results show that migration affects allocation of labour in Maize production. Migration influences the positively total labour and family labour person days but does not affect hired labour person days. This is mainly temporary migration which affects person days by about 15-28 person days. Permanent migration does not affect labour person days in Uganda. The results show that remittances positively affect maize cultivation mainly through the cost of hired labour. Local remittances have more significant effect on cost of hired labour compared to abroad remittances.

The results show that temporary migration have a positive effect on the allocation of labour in the maize cultivation. They tend to complement maize cultivation in Uganda. In addition, remittances affect maize cultivation through mainly absorbing the cost of hired labour. Although, abroad remittances are important in this process, focus should be more towards local remittances which have a more effect in Maize cultivation. The results show that migration and remittances can complement credit in Maize production in of purchases of labour and use of hired labour. They are also substitute for off-farm activities in the rural areas.

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Table A1: Descriptive summary for the migrants variables used in the estimations in Uganda

Explanatory Variables	**Households with no migrants (means)**	**Households with migrants (means)**	**Mean comparison test**
Total	2,893	2,173	
Family Labour (person days)	232.6055	282.3813	-6.9716***
Hired Labour (person days)	20.26861	40.48277	-2.6223***
Total labour (person days)	255.9232	325.8751	-6.5642***
Household's characteristics			
Age of the household head (years)	37.30107	37.90796	-1.0866
Gender of household head (Male=1)	0.657449	0.6682006	-0.8006
Formal Education of household head	0.8002074	0.8541187	-4.9839***
Household Size	5.437262	7.496088	-24.4913***
Dependency Ratio	0.2644776	0.1635002	20.4764***
Married	0.5737988	0.628624	-3.9432***
Location (Urban=1, Rural=0)	0.1130315	0.138058	-2.6784***
Productive characteristics			
Plot size (acre)	0.6515056	0.71129	-1.1330
Title	0.1742136	0.2489646	-6.5338***
Livestock	0.5578984	0.6129775	-3.9384***
Assets (numbers)	4.5646	6.361457	-10.9224***
Intercropping (%)	34.19372	32.58684	2.4385***
Credit	0.2053232	0.257248	-4.3699***
Off-farm	0.4683719	0.4758399	-0.5269
Networks			
Family migration networks	0.1832008	0.2659917	-7.0888***

Community migration networks	0.2309022	0.3722964	-11.0896***
Work migration network	0.171794	0.2535665	-7.1458***

Note: Statistical Significance at 99(***), 95% (**) and 90% (*) confidence levels.

Table A2: Descriptive summary for the variables used in the estimations in Uganda

	Uganda		
Explanatory Variables (Means)	Households No Remittances N= 3,390	Households using Remittances N= 1,676	Mean comparison test
Outcome			
Total production per plot (kgs)	734.25	722.03	0.07
Cost of seeds (Ushs)	9501.46	9116.37	0.19
Cost of manure (Ushs)	4639.49	3854.60	0.19
Cost of fertilizer (Ushs)	6992.92	3661.13	1.57*
Cost of pesticide (Ushs)	6859.32	5843.62	0.97
Cost of hired labour (Ushs)	70708.57	63861.07	1.15
Cost of inputs (Ushs)	66952.47	53595.26	2.15**
Household's characteristics			
Age of the household head (years)	35.69	41.36	-9.75***
Gender of household head (Male=1)	0.73	0.54	13.72***
Formal Education of household head	0.84	0.78	5.16***
Household Size	6.42	6.13	3.06***
Total Labour days	286.98	283.81	0.28
Married	0.63	0.53	7.07***
Location (Urban=1, Rural=0)	0.12	0.14	-2.16***
Productive characteristics			
Plot (acre)	0.72	0.60	2.21***
Inter-cropping (%)	33.17	34.20	-1.50*
Title	0.21	0.21	-0.30
Soil type	0.65	0.58	4.33***

Livestock	0.58	0.59	-1.32*
Assets (number)	5.44	5.10	1.96**
Wages (in local currency)	47949.13	46837.04	0.15
Off-farm	0.50	0.42	4.74***
Shocks	0.60	0.65	-2.98***
Sales(in local currency)	331969.8	266977	2.48***
Institutional variables			
Credit	0.53	0.55	-0.98
Other sources of income	0.57	0.51	2.14***
Others transfers	0.07	0.08	-1.86**
Extension services	0.19	0.18	0.64

Note: Statistical Significance at 1(***), 5% (**) and 10% (*) confidence levels.

Table A3: The instruments for Migration and remittances in Uganda

	Community experience	**Both Family networks and Community experience**
The instruments for migration		
Test for Endogeneity		
Durbin (score) chi2(1)	3.56318 (p = 0.0591)	1.64098 (p = 0.2002)
Wu-Hausman F(1,5042)	3.5488 (p = 0.0596)	1.63406 (p = 0.2012)
Minimum eigenvalue statistic	12.3388	6.45502
Prob > F	0.0004	0.0016
The instrument for remittances		
Test for Endogeneity	**Work and income reasons**	
Durbin (score) chi2(1)	0.968358 (p = 0.3251)	
Wu-Hausman F(1,5042)	0.964528 (p = 0.3261)	
Minimum eigenvalue statistic	23.2382	
Prob > F	0.000	